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中国能源消费的二氧化碳排放实证研究

Empirical Study on Carbon Dioxide Emissions Related to
China's Energy Consumption

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摘 要

全球气候变暖已成为 21 世纪人类面临的最重大环境问题之一。目前科学界认为：温室气体是导致全球气候变暖的主要因素，缓解全球气候变暖的根本措施是减少温室气体尤其是二氧化碳（Carbon Dioxide CO₂）的人为排放；而能源消费被认为是 CO₂ 主要排放活动之一。中国作为全球最具活力的发展中国家，同时也是第一大 CO₂ 排放国，其 CO₂ 减排已成为国际社会关注的热点问题之一。研究中国的 CO₂ 排放问题，不仅有利于中国的可持续发展，而且对缓和全球气候变暖具有重要意义。

因此，本论文利用现代计量模型和方法研究中国能源消费相关的 CO₂ 排放问题，对 CO₂ 排放量及其排放强度的变化进行了因素分析，以期找出缓减中国 CO₂ 排放量增长速度的潜在原因。通过实证分析，论文主要取得如下三方面的创新：

（1）利用结构分解分析（SDA）法研究了中国完全 CO₂ 排放强度及其排放量变化的原因。研究结果表明：经济增长是中国完全 CO₂ 排放量增长的绝对主导因素。不同时段，生产模式（包括碳排放系数、能源结构、生产技术和能源消费强度）和需求模式（包括最终需求产品结构和最终需求分配结构）对 CO₂ 排放强度变化作用方向和贡献程度均不同。但总体上，促使中国完全 CO₂ 排放强度降低的原因是生产模式的转变，其中能源消费强度是主要因素；需求模式尽管很重要，但是在研究中其变化并未对 CO₂ 排放强度的降低起到明显的作用，还需要进一步研究较适合的需求模式。基于这些结论，提出中国在未来的经济发展中，在进一步转变生产模式的同时，也需注重需求模式的改变，从而达到经济增长和 CO₂ 减排的双重目标。

（2）基于对数平均迪氏指数（LMDI）分解模型对中国区域（省区）能源消费相关的 CO₂ 排放量影响因素进行了完全分解研究。1997-2007 年间 10 个时段东中西三大区域的研究表明：经济增长其 CO₂ 排放量增加的绝对主导因素；产业结构的变化加剧了 CO₂ 排放量的增加；能源消费强度的下降是 CO₂ 排放量减少的重要原因；而能源结构和碳排放系数对 CO₂ 排放量变化的影响作用比较小。

其中，经济增长对东中西三大区域 CO₂ 排放量变化的影响程度，不同时段均是东部最大，中部次之，西部最小；而其余四个因素却不同，各因素不同时段对三大区域的影响程度交叉出现，没有一定的规律可以遵循。2006-2007 年间省区研究表明：经济增长导致了各省市自治区 CO₂ 排放量的增加，但影响程度不同；除北京、上海外，其余 26 个省市自治区产业结构的变化均导致 CO₂ 排放量的增加，但增量不大；能源消费强度是减缓各省市自治区 CO₂ 排放量增长的最重要因素；能源结构变化和碳排放系数相似，对不同省市自治区 CO₂ 排放量变化的影响方向和程度均不同，且对 CO₂ 排放量变化贡献整体较小。基于这些结论，提出通过进一步提高能源效率、促进地区经济发展、调整产业结构、完善能源结构和降低电力碳排放系数等途径来减缓当前 CO₂ 排放量的增长速度。

(3) 利用面板数据模型对中国经济增长与能源消费强度差异的 β 收敛性进行实证分析，并探究了导致其与发达国家能源消费强度差异的深层原因。结果表明：中国与八个发达国家人均GDP的差异每降低1%，会导致中国与八国能源消费强度差异减小3.33%。其原因在于，决定经济增长的因素对能源消费强度会产生积极的影响，产业结构差异、固定资产投资差异、技术进步差异和价格竞争机制差异的减小可以降低中外能源消费强度的差异。这些分析结论为中国能源消费强度的进一步下降提供了努力的方向。

关键词：二氧化碳排放；能源强度；分解

Abstract

Global warming is becoming one of the most serious environmental problems that we are faced up to. Greenhouse gases are thought to be the main cause. To solve the problem, the fundamental measure is reducing the emission of the greenhouse gases, especially carbon dioxide(CO₂) emissions. Among the numerous channels that are contributing to this emission, the consumption of fuel plays an important role. As one of the most dynamic developing country, as well as the largest CO₂ emissions country, China's reduction of such gas is becoming a worldwide hot topic. The research of the problem is not only helpful to China's sustainable development but also helpful to mitigating the global warming tendency.

Modern econometric models and methods are used in this dissertation to investigate the potential reasons that influence the change of the magnitude and the intensity of the CO₂ emissions in China, and hope to find the potential ways to slow down the increment speed of the CO₂ emissions. The main conclusions and contributions of this dissertation include:

(1) By using SDA method, we find out that economic development has always been the dominant factor for the growth of China's total CO₂ emissions. And the production mode and the demand mode in different stages contribute differently to the change of CO₂ emissions intensity. As a whole, it is the transformation of the production mode that mainly contributes to the reduction of CO₂ emissions intensity, especially the energy intensity is the main factor. Despite of the importance of the demand mode, there is no obvious effect to reduce the intensity of CO₂ emissions in the study, more efforts are to be needed to find a suitable demand mode. Based on the analysis, we suggest that in China's future development process, we should also pay attention to the transformation of the demand mode when making further efforts to the transformation of the production mode in order to achieve the dual purposes of the economic development and the carbon emissions reduction.

(2) By using LMDI model and the data between 1997 and 2007 of the eastern, middle and western China regions, conclusions indicate that the economic development leads to the increase of CO₂ emissions, the changes on industrial

structure aggravates the increase of CO₂ emissions, the decline of energy intensity is a primary factor that reduce the emissions of CO₂, but energy structure and carbon emission factor explain less. We also find that the degree of the economic development that influences the change of the CO₂ emissions varies from region to region, the extent weakened from eastern to western China. However, for other four factors, there are no apparent rules to explain the regional differences. A provincial study in 2006 and 2007 shows similar conclusion that economic development leads to increased CO₂ emissions, but impacts differed from different provinces. The Uncoordinated industrial structure can also accelerate the increase emissions of CO₂ in most regions except Beijing and Shanghai, though the degree is weak. The energy intensity is a good instrument that can help to reduce CO₂ emissions in most provinces. Similar to the Carbon emission factor, Structural changes in energy consumption contributes less to the CO₂ emission in the direction and degree of the different provinces. Hence it is obvious to argue that, there are many ways that can effectively reduce the growth of the CO₂ emissions, including significantly improving energy efficiency, promoting regional economic development, adjusting the industrial structure , perfecting the energy consumption structure and reducing electricity carbon emission factor, etc.

(3) An empirical study based on the panel data is conducted, focusing on the Beta Convergence of the relationship between the economic development and energy intensity, accompanied by a deep study on the differences between the developed countries and China. The result shows that a decrease on this difference of 3.44% would be observed with a decrease on GDP of 1%.The Mechanism is that the factors that determine the economic growth can produce positive influences on energy intensity, the difference of the industrial structure, of the fixed asset investment, of the technological progress, and of the price competition of all countries can reduce the differences on energy intensity. By this further study, a direction for further reduction on energy intensity of China in near future would be expected.

Keywords: Carbon Dioxide emissions; Energy Intensity; decomposition

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